

REMARKS

The foregoing amendments and these remarks are in response to the Office Action dated February 19, 2009. Applicant respectfully requests a one month extension of time and authorization is given to charge the appropriate fees to Deposit Account No. 50-0951.

At the time of the Office Action, claims 1-48 were pending in the application. In the Office Action, claims 1-48 were rejected under 35 U.S.C. §102(b). The rejections are discussed in more detail below.

I. Rejections to the claims based upon Art

Claims 1-48 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,170,264 to Viteri et al. (hereafter "*Viteri*"). Claims 1-48 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,359,118 to Latter et al ("*Latter '118*"). Claims 1-48 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,354,565 to Latter et al ("*Latter '565*"). Claims 1-48 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 3,886,733 to Connell et al ("*Connell*").

With regard to the documents cited in the Office Action, Applicant notes that the Examiner cited document US 4,354,665. Applicant has assumed herein that US 4,354,565 (*Latter '565*) is the correct reference. Moreover, applicant notes that *Latter '565* belongs to the same patent family as *Latter '118*.

a. Discussion of claim amendments

Claim 1 has been amended to include the following features:

a) the gasifying means (M) comprises a heat exchanger (33) for a starting gasification of the liquid gas in communication with the liquid gas tank (28);

b) a close housing (21) wherein a gasification chamber (22) is formed; the gasification chamber (22) being in fluid communication with the expansion chamber (9) through a port (23) so that the entire gas mixture, which comprises compressed liquid gas and gaseous products and by-products of the combustion process, passes into the expansion chamber (9), and between the port (23) of the gasification chamber (22) and the expansion chamber (9) an intake manifold (16)

and an intake duct (10) are placed, wherein the intake duct (10) puts in communication the expansion chamber (9) with the intake manifold (16) through a respective intake valve (12);

d) controlling means are provided for opening said intake valve (12) for a first duration (AB) in such a way that the piston (6) of the engine is pushed by a constant pressure of the gas from the gasification chamber (22), and for closing said intake valve (12) for a second duration (BC) in such a way the piston is pushed by gas expansion;

e) wherein the gasification chamber is split into a first gasification chamber and a second gasification chamber for combustion of the liquid fuel with the oxygen under conditions of saturated steam and overheated steam respectively, each of said first and second gasification chambers comprising a respective pilot igniter.

Support for feature a) is to be found at least in previous claim 4 and in the originally filed international application on page 5, lines 6 to 11. Support for feature b) is to be found at least in the originally filed international application on page 3 lines 7-8. Support for feature c) is to be found at least in the originally filed international application on page 3 lines 1-10, on page 5 lines 21-24, and on page 9 lines 22-23. Support for feature d) is to be found at least in the originally filed international application on page 5 line 15 to page 6 line 8. In particular, in this part of the description it is clearly disclosed that means are provided for controlling the aperture of the intake valve and the closure of the fluid communication between the gasification chamber (22) and the expansion chamber (9) during the power stroke of the piston. Feature d) was also partially and briefly disclosed in previous claim 19. Support for feature e) is to be found at least in previous claim 15 and in the originally filed international application on page 3, line 36, and on page 4, line 7.

Claim 2 has been brought into conformity with amended claim 1. Claim 3 has been amended and now includes the feature that controlling means are provided for opening said exhaust valve (13) in such a way that the cylinder is emptied of the spent gas, which is discharged in the ambient atmosphere, and for closing said exhaust valve (13) so that a pressure increase occurs within the cylinder until a pressure value is reached, which is the same as that of the gasification chamber (22). Support for this feature is to be found at least on page 5 line 15 to page 6 line 13 of the originally filed international application. In particular, in this part of the description

it is clearly disclosed that means are provided for controlling the aperture of the exhaust valve and the closure of the fluid communication between the gasification chamber (22) and the expansion chamber (9) also during the exhaust stroke of the cylinder. The content of claim 3 was also partially and briefly disclosed in previous claim 20.

Pending claims 4, 9, 15, 19 and 20 have been canceled. Amended method claim 21 further includes the features that:

- f) the engine (3) has an expansion chamber (9) provided with a cylinder (5) and a piston (6) arranged for completing cyclically a power and an exhaust stroke at each double stroke;
- g) a starting gasification is achieved by a heat exchanger (33) extracting heat from the ambient atmosphere;
- h) the gasification is further achieved in a close housing (21) in which a gasification chamber (22) is formed, the further gasification step of the liquid gas taking place in a distinct gasification area where the oxygen and fuel combustion is performed, the combustion heat being conveyed into the gasification area, the combustion taking place in the presence of a pilot igniter;
- i) the entire gas mixture, which comprises compressed liquid gas and gaseous products of the combustion process, passes through an intake manifold (16) through a port (23) of the gasification chamber (22) and, from here, through an intake valve (12) into the expansion chamber (9);
- j) a working stroke of the piston (6) is achieved by opening the intake valve (12) for a first duration (AB) and pushing the piston (6) at a constant pressure, and by closing the intake valve (12) for a second duration (BC) and pushing the piston (6) by gas expansion.

Support for feature f) is to be found at least on page 2 lines 35-38 of the originally filed international application. Support for feature g) is to be found at least in the content of pending claim 22, and in the originally filed international application on page 5 lines 6 to 11. Support for feature h) is to be found at least in the originally filed international application on page 3 lines 7-8 and line 36, on page 4 line 7, and in previous claims 22 and 27. Support for feature i) is to be found at least in the originally filed international application on page 3 lines 7-10, on page 5 lines 15-24 and on page 9 lines 22-23. Support for feature j) is to be found at least in the originally filed international application on page 5 line 15 to page 6 line 8.

Pending claims 22, 25, 27 and 29 to 48 have been cancelled.

New claim 49 has been added. Support for new claim 49 is to be found at least on page 5 line 15 to page 6 line 8 of the originally filed application. New claim 50 has been added, based on previous claim 28.

b. Discussion of Cited Documents

Applicant notes that the European Examiner acknowledged the patentability of the subject matter of claim 1 in the corresponding European patent application (*Viteri* was not considered in the European examination procedure), mainly based on the features that the engine unit comprises two gasification chambers (a first gasification chamber and a second gasification chamber for combustion of the liquid fuel with the oxygen under conditions of saturated steam and overheated steam respectively), wherein each gasification chamber comprises a respective pilot igniter. These features have been duly introduced into amended claim 1 herein.

With respect to *Viteri*, this document discloses a combustion engine comprising an air treatment device and a fuel combustion device, the combustion engine providing clean power by the combustion, in the fuel combustion device, of a fuel including hydrogen and carbon with O₂ enriched air obtained in the air treatment device. The air treatment device includes means to remove at least a portion of the nitrogen from the air supplied to the combustion engine. The nitrogen removal means includes means to cool the air to a temperature at which oxygen in the air liquefies for separation of the oxygen from the nitrogen. The combustion engine thus produce power and steam. Therefore, the engine disclosed in *Viteri*, essentially, consists of an internal combustion engine.

The engine unit according to the present application comprises an engine supplied with a compressed gas and having an expansion chamber. In particular, in the engine unit according to the present claims, a liquefied gas is expanded and, therefore, used as a spring, while a very small quantity of fuel is used in order to gasify the gas.

In view of the above, it is submitted that the present claims are novel and inventive over *Viteri*.

With respect to the *Latter '118* and *Latter '565* patents, the engine unit according to amended claim 1 is different from the apparatus disclosed therein for at least the following reasons. *Latter '118* is specifically referred to by Applicant for the sake of convenience but as both references are part of the same patent family the comments apply equally to either reference.

The engine unit of the present application provides one expansion unit, which is placed downstream from the gasifying means (M). Therefore, the gasifying means, which comprises both a heat exchanger (33) in communication with the liquid gas tank (28) and a close housing (21) in which a gasification chamber (22) is formed, generates a gaseous mixture which entirely passes into the same expansion chamber (9).

In other words, according to the present application, the expansion chamber (9) is supplied with gaseous products, that are generated both in the heat exchanger and the gasification chamber. This is because the heat exchanger and the gasification chamber are put in sequence directly the one after the other, in such a manner that the entire gas mixture comprising both compressed gas and gaseous products of combustion process passes into the expansion chamber (9) to do useful work.

To the contrary, *Latter '118* discloses two expansion units or stages, namely two separated expansion engines 52 and 62 (see column 6 lines 5 to 48). In particular, there are two heat exchangers 44, 46 put in communication with the first expansion engine 52 in such a manner that only some compressed gas is used to do useful work in the first expansion engine 52.

Furthermore, downstream from the first expansion engine 52, there is a heating apparatus 58, wherein remaining gas (which is not used to do useful work in the first engine unit) is heated by combustion. The heating apparatus 58 is put in communication with the second expansion engine 62, in such a manner that the remaining heated gas (and the products of combustion) is used to do additional useful work in the second expansion engine 62.

As a matter of fact, *Latter '118* explicitly recites as follows:

"At the output 56 from the first stage expansion engine 52, the gas is still at an elevated pressure, but may be at a temperature below ambient. After valving 60, in the heating apparatus 58, the gas is raised to an elevated temperature and pressure by periodically burning fuel (for example, LNG as discussed below) prior to being used in the adiabatic expansion engine 62. Power output

from engine 62 is indicated at shaft 64. The exhaust gases from engine 62 are transmitted through conduit 66 to the outer zone of the countercurrent heat exchanger 42, and are cooled as the incoming liquefied gas changes to the gaseous state. Accordingly, the exhaust gases at 68 from the engine are relatively cool."

Therefore contrary to the present claims, according to *Latter '118*, the heat exchanger 44, 46 and the heating apparatus 58 are not put in sequence directly the one after the other, and the gas mixture comprising both compressed gas and gaseous products of the combustion process does not pass entirely into the same expansion chamber to do useful work. Therefore, it is submitted that the present claims are patentable over *Latter '118* (and, similarly, *Latter '565*).

An additional difference relates to the port (23) of the present application. *Latter '118* does not disclose that the gasification chamber (22) is further in fluid communication with the expansion chamber (9) through a port (23) and that between the port (23) of the gasification chamber (22) and the expansion chamber (9) an intake manifold (16) and an intake duct (10) are placed, wherein the intake duct (10) puts in communication the expansion chamber (9) with the intake manifold (16) through a respective intake valve (12). In particular, *Latter '118* does not specifically disclose any port.

A port is to be interpreted as "a small opening in the wall of a container or vessel especially for viewing or for the controlled passage of material". In other words the port of the gasification chamber is a small aperture made on the wall of the gasification housing, and is specifically provided for providing a fluid communication between the gasification chamber and the intake manifold. The term "port" should thus not be construed as a conduit, a pipe, or the like, but specifically as a hole or slit made in the housing wall of the gasification chamber.

This port ensures that a defined mass of compressed gas is introduced from the gasification chamber into the intake manifold, and then in the expansion chamber, at a constant pressure, and with minimum heat transfer between the gasification chamber and the intake manifold. Also the originally filed drawings show such a port 23 in an explicit manner.

Moreover, Applicant believes that common expansion engines (namely engines with piston and cylinder) have a completely different structure with respect to the engine of the present application. In particular a commonly known expansion engine has a unique intake conduit C,

having a constant diameter, which replaces the port, the intake manifold and the intake duct of the present invention (see claim 1). Such an intake conduit C is placed upstream from the expansion chamber to deliver a mixture of fuel and air thereto.

For the sake of clarity for the following argument, Applicant provides an altered figure 1 below which has been changed so as to include a common expansion engine. A clear difference with respect to actual figure 1 can be seen.

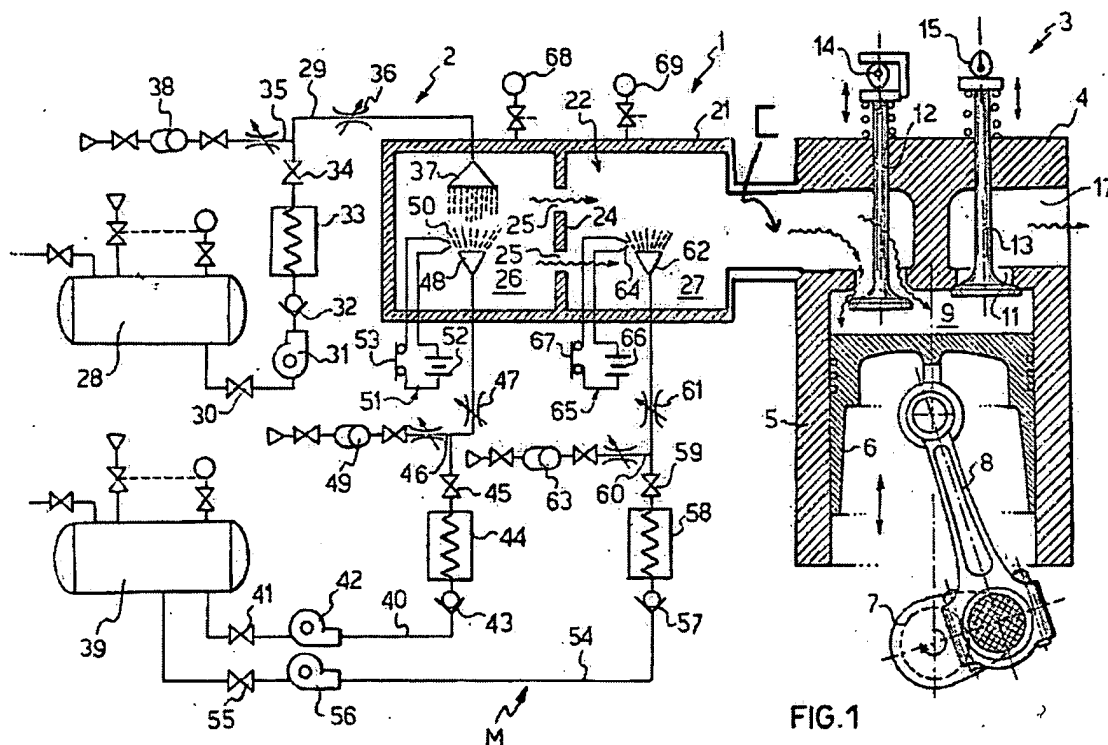


FIG.1

This difference is because a commonly known expansion engine works in a suction mode. Therefore under suction condition, it is desired to have the largest possible intake conduit C so as to avoid turbulence of the air and fuel mixture. Otherwise a plurality of different cross-sections of a passageway would influence the gas flow.

On the contrary, the engine unit of the present application works in a pressure mode, and therefore the gas flow is not influenced by the cross-sections of the passages. In fact, as set above, the port according to the present application consists of a small hole.

Therefore, by using the largest possible intake conduct C (as hypothetically disclosed in altered figure 1 shown above), if the intake valve 12 were open (first duration AB), a mass transfer of compressed gas would occur with thermodynamic transformation, namely heat would be added to the expansion chamber through the intake conduct C. Therefore, during the first duration AB, compressed gas with transfer of heat would push the piston.

Accordingly, it is submitted that also the second expansion engine 62 of *Latter '118* is connected to a heating apparatus (58) through a single intake conduct having a constant cross-session. There are no indications in *Latter '118* about any port and any intake manifold. For this reasons, applicant respectfully submits that the port, the intake manifold and the intake duct are not implicit from *Latter '118*.

More particularly, the heating apparatus and the second expansion engine of *Latter '118*, due to their direct interconnection, contrary to the present application, allow heat (provided by the heating apparatus (58)) to be transferred to the expansion chamber during the pushing step of the piston in the expansion chamber. Again, these arguments apply equally to *Latter '565*.

In the light of these differences, the present claims solve the technical problem of providing an engine unit and related method, which allows to control, with minimum heat transfer, the amount of compressed gas supply to the expansion chamber obtaining a high efficiency, similarly to the efficiency of a mechanical spring.

With respect to *Connell*, it appears that the method of this document is suitable for an aircraft jet engine starting device. On the contrary, the method according to the present claims is apt for completing cyclically a power and an exhaust stroke at each double stroke. In other words, the method of the present claims is apt for continuously imparting motion to a vehicle, not to a starting device. In addition, the method of *Connell* fails to disclose the above-mentioned features g), h) and j) of amended claim 21.

For the foregoing reasons, the independent claims are believed to relate to patentable subject matter, and to be in condition for allowance. The dependent claims are also believed allowable because of their dependence upon allowable base claims, and because of the further features recited.

U.S. Patent Appln. No. 10/561,077
Amendment
Reply to Office Action dated February 19, 2009

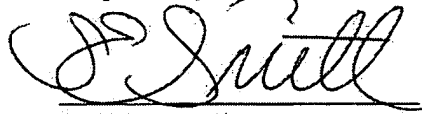
Docket No. 7202-101 (181418)

II. Conclusion

Applicant has made every effort to present claims which distinguish over the prior art, and it is thus believed that all claims are in condition for allowance. Nevertheless, Applicant invites the Examiner to call the undersigned if it is believed that a telephonic interview would expedite the prosecution of the application to an allowance. In view of the foregoing remarks, Applicant respectfully requests reconsideration and prompt allowance of the pending claims.

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Respectfully submitted,



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